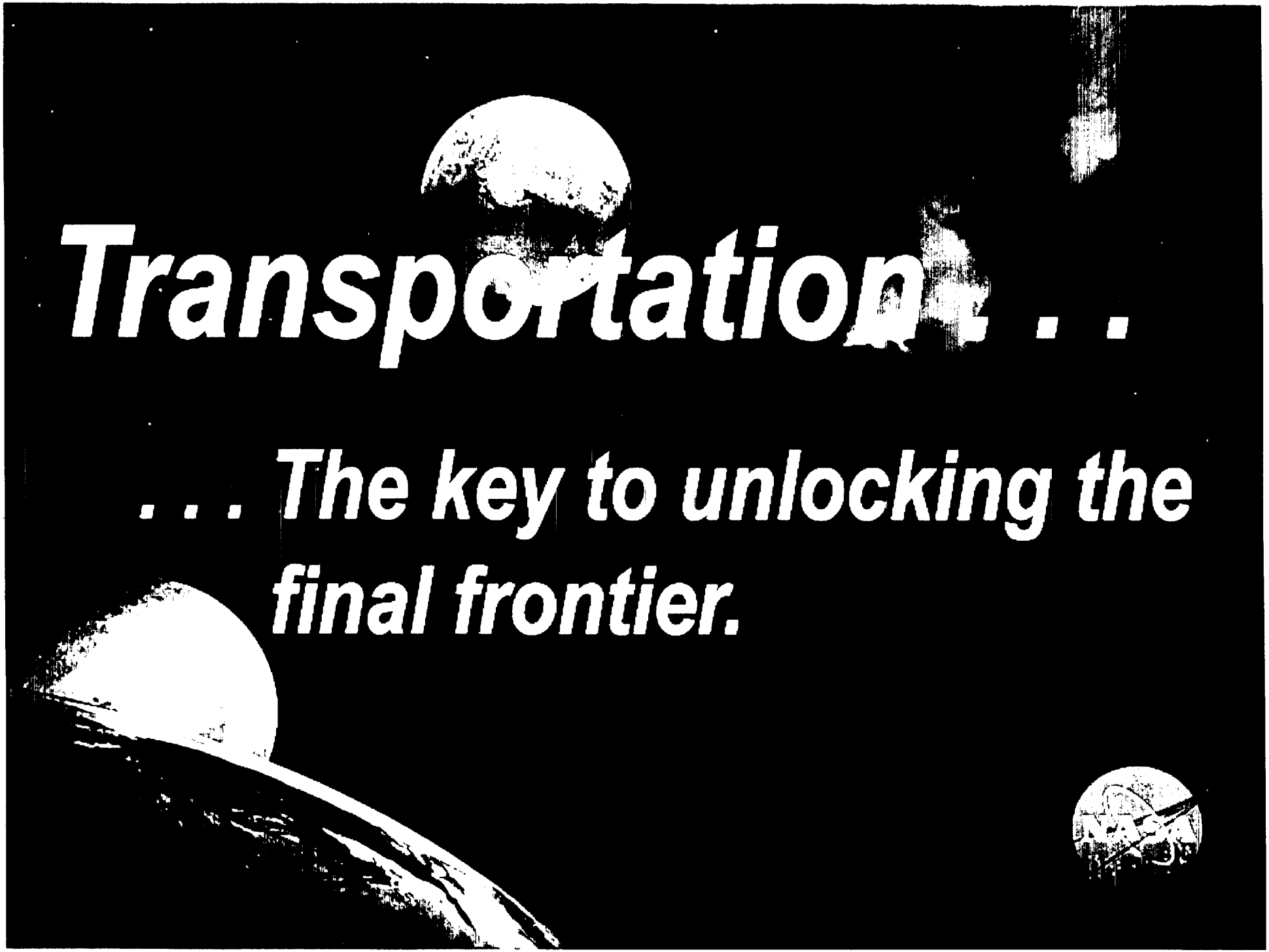

Transportation . . .
. . . The key to unlocking the final frontier.

The Last Frontiers

- For this future generations in this new millennium, only two new frontiers remain to be explored and developed by humans:
  - Under the oceans, seas and lakes (about 80 percent of the Earth)
  - The vast reaches of near and outer space

- We are slowly running out of resources while this planet's population is exploding.
  - Rapidly/exponentially approaching 7 billion people while we started the 20th century at barely 1 billion
  - Running out of food, water, sources of fossil energy, and maybe even the very air we must breath as the human race continues to pollute everything it touches

- We must establish new, highly reliable and low-cost ways to colonize under the seas and to get people permanently off "Spaceship Planet Earth"!!

The Last Frontiers (cont'd)

- **We are in similar position to the European continent in the 15th century when the people were dying from starvation, new terrible diseases (e.g., Bubonic Plague) and general overcrowding.**
- **We must establish new colonies permanently in space because it is vital to the ultimate survival of the human race.**
- **Reliable and affordable space transportation for routine human travel into space and the planets is once again the key to developing this last great frontier.**
- **This talk will now focus on what NASA is now doing to initiate the process in earnest.**
- **We may well be at another historical moment in NASA's evolution with an opportunity to help humans in fundamental ways.**
  - Similar to the Apollo program 40 years ago.

The Last Frontiers (cont'd)

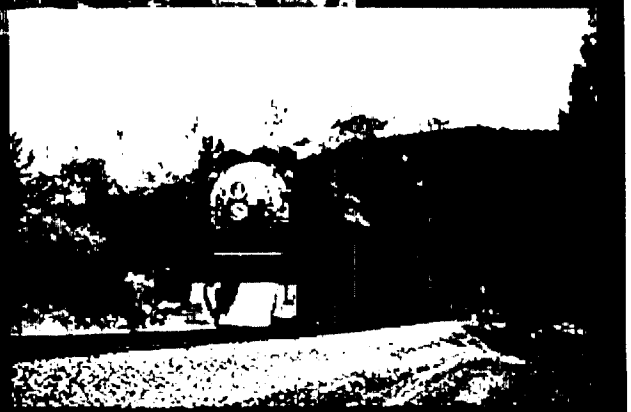
- **Space transportation is the key, and once again will only meet the needs with new generations of competent, talented, and innovated mechanical engineers.**

- **Now let us look at how we may begin this process.**

The New World

The American West

Transportation . . . Opened Our Frontiers



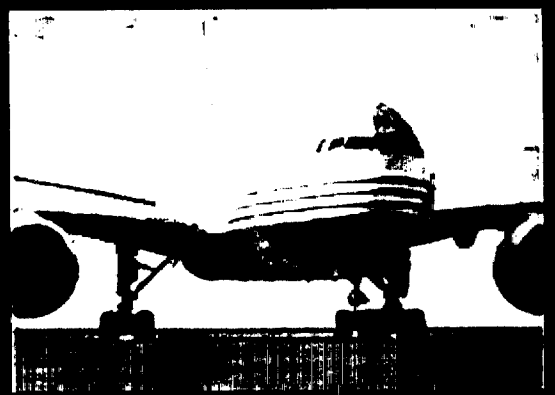
Transcontinental Travel

The Dawn of Flight

International Commerce

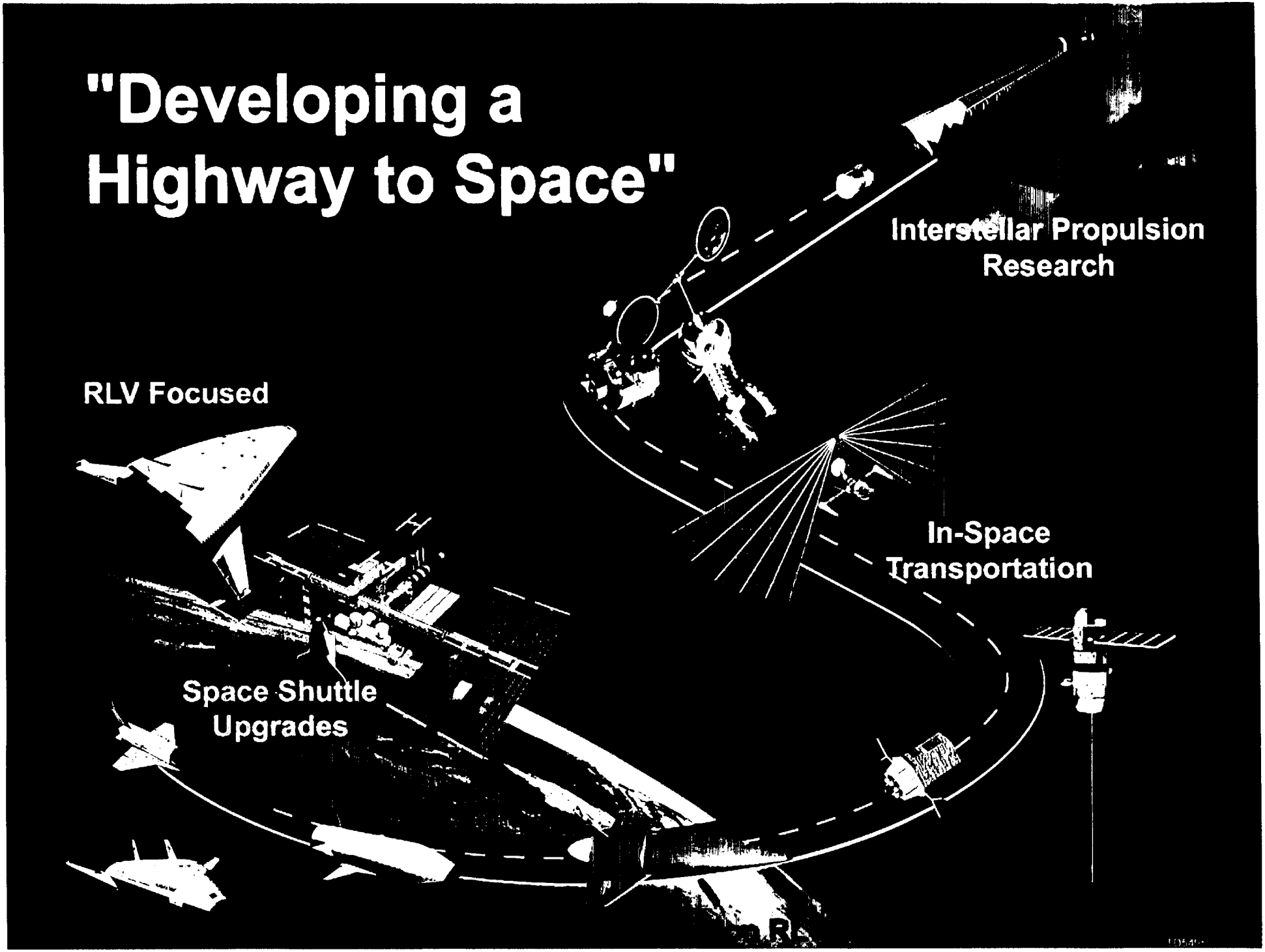
6 1/2 Generations of Airliners in a Century

Wright Flyer (1903)

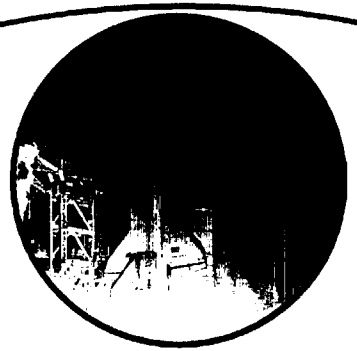


Boeing 777 (Today)

1st Generation Reusable Launch Vehicle (1981 – Today)


"Developing a Highway to Space"
Interstellar Propulsion Research
RLV Focused
In-Space Transportation
Space Shuttle Upgrades

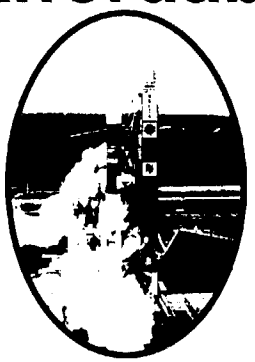
A Balanced Space Transportation Program



Human Exploration & Development of Space

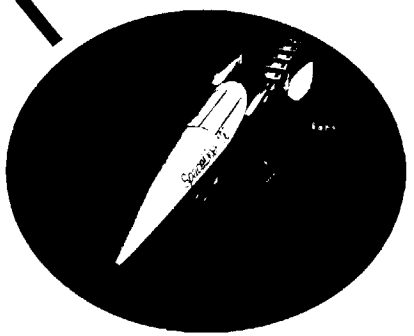
- Shuttle Upgrades
- X-38
- ISS Propulsion Module
- Exploration

Assured, Reliable, Safe, Affordable Space Transportation



Commercially Provided Expendable Launch Services

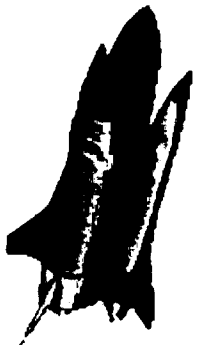
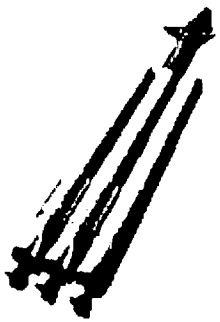
- Commercial / DoD Lead



Development of Future Improved Capabilities

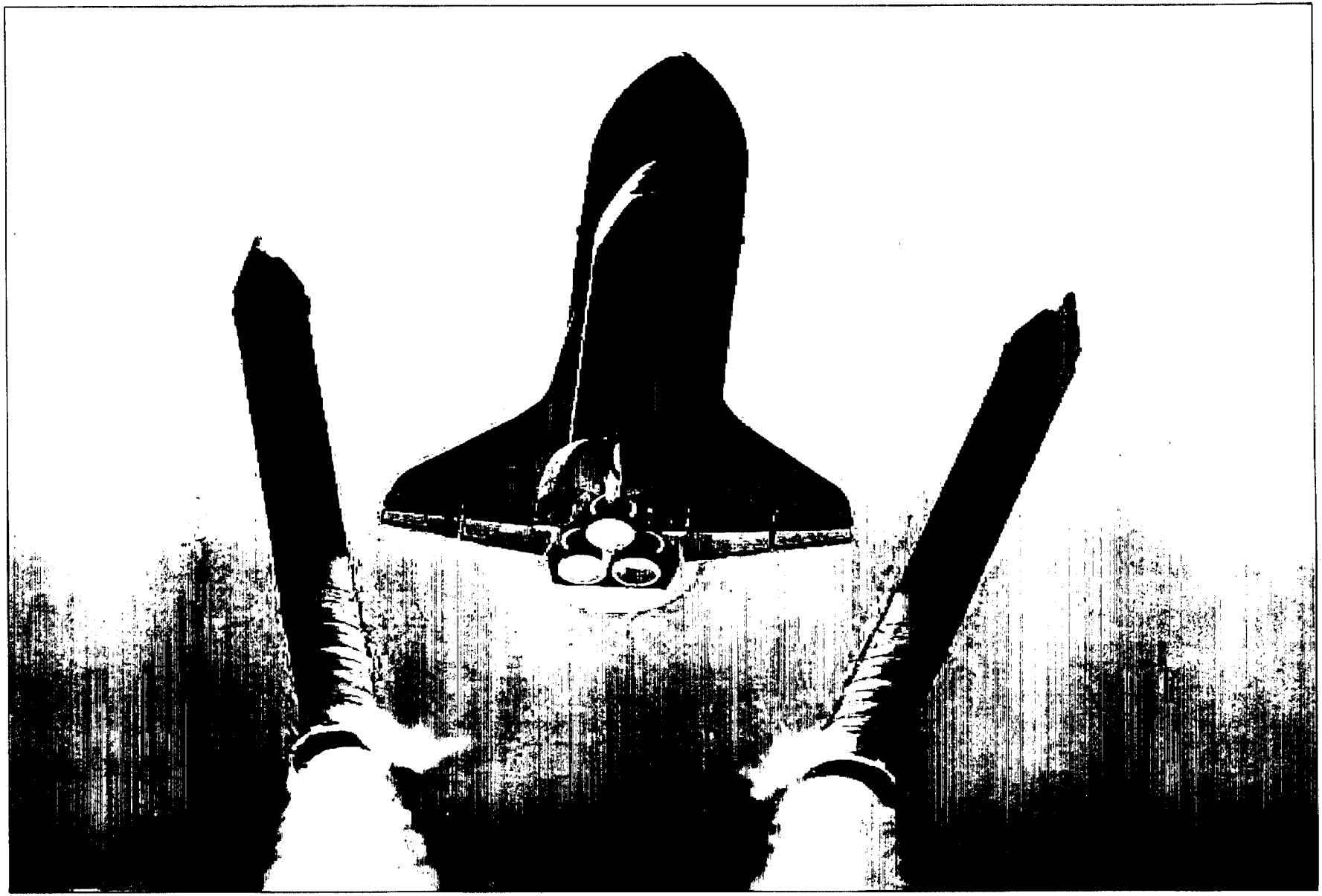
- Future X (X-33, X-34, X-37)
- Pathfinder
- ASTP

Architecture Summary

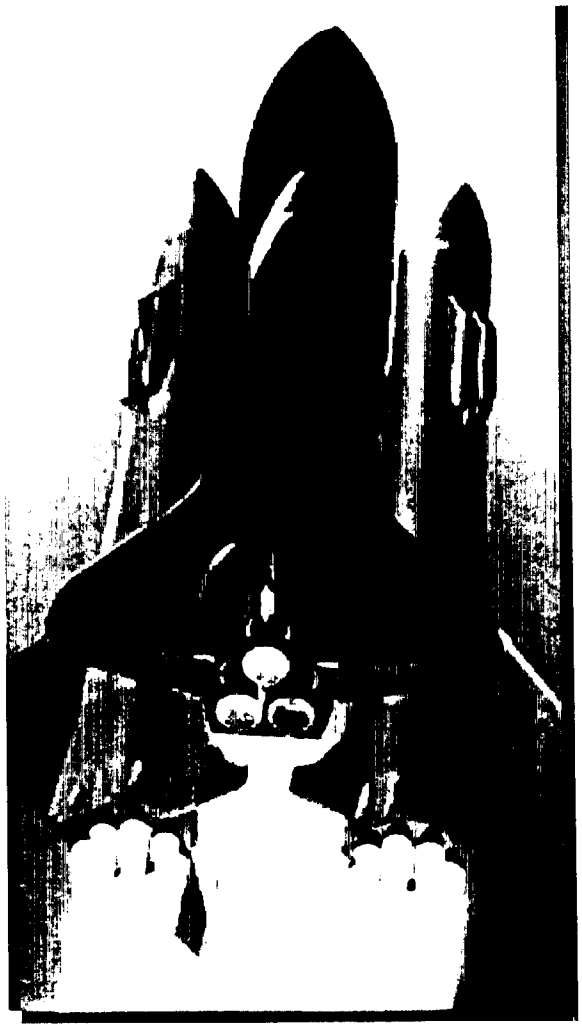
	Architecture 1	Architecture 2	Architecture 3	Architecture 4	Architecture 5
Key Features	• **Shuttle to 2020** • **Phase III Upgrades**	• **Shuttle w/Phase III Upgrades to 2020 with a Reusable First Stage**	• **Replace Shuttle** • **EELV Heavy Launch** • **New Crew/Cargo Transfer Vehicle(s)**	• **Replace Shuttle** • **New TSTO Launch** • **Crew Transfer Vehicle/Module**	• **Replace Shuttle** • **New SSTO Launch** • **Crew Transfer Vehicle/Module**
Key Options	• Comm'l Shuttle • Exploration	• Comm'l Shuttle • Exploration • RFS Derived Vehicles	• Partial ISS Downmass • Exploration	• Comm'l TSTO • Exploration • Alternate Access on EELV	• Comm'l SSTO • Exploration • Alternate Access on EELV
Potential New Elements	• Low Cost Upperstage • Magnum • EELV	• Low Cost Upperstage • **Reusable First Stage** • New Orbital Stage • **Magnum** • **EELV**	• **Crew Transfer Vehicle** • **Cargo Transfer Vehicle** • Crew/Cargo Transfer Vehicle • ATV • **Magnum** • **EELV (human rated)**	• Low Cost Upperstage • **New TSTO** • **Crew Transfer Vehicle** • **Magnum** • **EELV** (human rated)	• Low Cost Upperstage • **New SSTO** • **Crew Transfer Vehicle** • **Magnum** • **EELV** (human rated)

Shuttle Safety Upgrades



Major Upgrades Under Evaluation

Five Segment Booster (FSB)



Reusable First Stage (RFS) Booster

Space Transportation Definitions

Integrated Space Transportation Plan (ISTP)

Shuttle Safety	Crew Return Vehicle	Space Launch Initiative	Aero-Space Base
• Supportability and Safety upgrades	• X-38	• 2nd Gen RLV Program • Systems Eng. and Requirements Definition • Competition and Risk Reduction • NASA Unique Systems • Alternate Access	• Information Technology • Vehicle Systems Technology • Propulsion and Power • Flight Research • Space Transfer and Launch Technology

2nd Generation RLV

Use of on-going Flight Demonstrators (X-33, X-34, X-37 and Exp.) to meet 2nd Gen Objectives

The Challenge

- ***Safer*, more *Affordable*, more *Reliable* Space Transportation is needed.**
  - The U.S. is losing its market share of space launch to overseas competition (improving 40 year old U.S. technology)
  - NASA's space transportation expenditures consume nearly 25% of NASA's annual budget.
  - Systems have typically focused on EITHER performance or simplicity
- ***NASA's role: To lead the development and demonstration of the requisite technologies to meet the above goals***

Risk Barrier

- The way to safe, reliable, affordable access to space is blocked by technical and business risk
- NASA and the Administration have developed an integrated approach to removing the risk barrier for a 2nd generation system:

Space Launch Initiative